FUNCTIONAL MATERIALS FOR USE IN OPTICAL SYSTEMS

CLAIMS

We claim:

1. A functional optical material for use in an optical system, comprising:
(a) a polymer selected from the group comprising,
(1) a thermoplastic polymer;
(2) a thermosetting polymer; and
(3) a combination of thermoplastic and thermosetting polymers;
wherein said thermoplastic and/or thermosetting polymers contain carbon-hydrogen and/or carbon-fluoride functionality; and
(b) one or more optically active chromophores blended and/or copolymerized with said polymer;
(c) a compatibilizer copolymerized with said polymer of step (a), having one or more pendant groups selected from the group consisting of nitriles, esters, aromatics; fluorinated esters, and fluorinated aromatics; and
(d) an adhesion promoter copolymerized with said polymer of step (a), having one or more pendant groups selected from the group consisting of nitriles, silanes, fluorinated silanes, organic acids; fluorinated organic acids, alcohols, fluorinated alcohols, amides, and amines; and
wherein when a compatibilzer with one particular pendant group is selected, an adhesion promoter with a different pendant group is selected.

2. The functional optical material according to Claim 1, wherein said thermoplastic and/or thermosetting polymer is selected from the group consisting of acrylics /methacrylics; copolymers of acrylic acid esters, methacrylic acid esters, and other single unsaturated monomers; polyesters; polyurethanes; polyimides; polyamides; polyphosphazenes; epoxy resin; and hybrid (organic-inorganic) or nanocomposite polyester polymers.

3. The functional optical material according to Claim 1, wherein said thermoplastic polymer is selected from the group consisting of acrylics/methacrylics (copolymers of esters of acrylic and methacrylic acid where the alcohol portion of the ester can be based on hydrocarbon, or partially or fully fluorinated alkyl chains); polyesters (where the diacid or diol can contain carbon-hydrogen aliphatic, aromatic or carbon-fluorine functionality); polyurethanes (where the diisocyanate can be aliphatic or aromatic and the diol can contain carbon-hydrogen or carbon-fluorine functionality); polyimides where the acid, amine, or diamine can be partially or fully fluorinated; polyamides (where the diacid or diamine can contain carbon – hydrogen aliphatic, aromatic or carbon-fluorine functionality); polyphosphazenes (where the polyphosphazene backbone structure can contain fluorinated aromatic or aliphatic functional groups, as well as, carbon-hydrogen functionality); epoxy resin (where the epoxy resin can contain carbon-hydrogen or carbon-fluorine functionality0 which can further be reacted with diacids or anhydrides (that also contain carbon-hydrogen or carbon-fluorine functionality); and hybrid (organic-inorganic) or nanocomposite polyester polymers (where the polyester component consists of aliphatic, aromatic carbon hydrogen or carbon-fluorine functionality and the inorganic components are based on silane or organometallic materials such as titanates, zirconates and other multivalent metal organics).

4. The functional optical material according to Claim 1, wherein functional optical material has a glass transition temperature above 100°C.

5. The functional optical material according to Claim 1, wherein said functional optical material has a refractive index value of less than about 1.5.

6. The functional optical material according to Claim 1, wherein said functional optical material has a refractive index value of greater than or equal to about 1.5.

7. The functional optical material according to Claim 1, wherein said functional optical material has between 0.1 and 10% of a promoter having an adhesive promotion group, or combination of adhesive promotion groups.

8. The functional optical material according to Claim 1, wherein said compatibilizer has nitrile, ester, fluorinated ester, and fluorinated aromatic groups.

9. The functional optical material according to Claim 1, wherein said adhesion promoter has nitrile, silane, fluorinated silane, organic acid; fluorinated organic acid, alcohol, and fluorinated alcohol groups.

10. The functional optical material according to Claim 1, wherein monomers are included that provide water resistance by having styrene and/or cycloaliphatic groups.

11. The functional optical material according to Claim 1, wherein said said functional optical material has between 0.1 and 20% of one or more compatibilizers for said one or more chromophores.

12. The functional optical material according to Claim 1, wherein there is less than 5 wt.% of hydrogen in the monomer repeat unit and other units of the functional optical material).

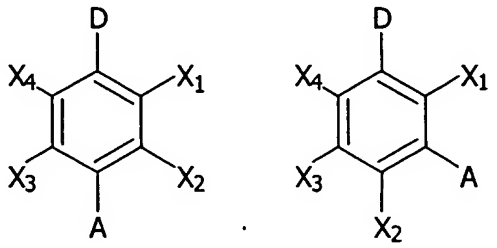
13. The functional optical material according to Claim 1, wherein said functional optical material has less than 2% water absorption according to a 24 hour water immersion test.

14. The functional optical material according to Claim 1, wherein said functional optical material requires less than 100 volts per micron of film thickness to pole said functional optical material.

15. The functional material according to Claim 1, wherein a compatibilizer is selected having a nitrile group, and an adhesion promoter is selected having a silane group.

16. The functional optical material according to Claim 1, wherein said one or more optically active chromophores is (are) selected from the group consisting of a substituted aniline, substituted azobenzene, substituted stilbene, or substituted imine.

17. The functional optical material according to Claim 16, wherein said one or more optically active chromophores are selected from substituted anilines comprising:
first substituted anilines,

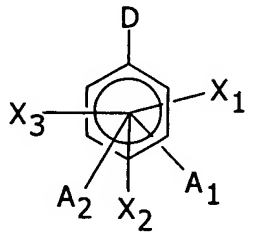


Wherein D = donor = $-NH_2$, $-N(CH_3)_2$, $-N(CH_2CH_3)_2$, or $-N(Y)_2$ where Y = alkyl alcohols, alkyl (hydrocarbon fluorocarbon) esters, or alkyl silane derivatives;

A = acceptor = $-NO_2$, $-C(CN)C(CN)_2$, or $-N=C(R1)(R2)$, wherein R_1= CF_3, C_2F_5, C_nF_{2n+1}, R_2= H, CH_3, CF_3, C_2F_5

wherein when A = = $—NO_2$, or $—C(CN)C(CN)_2$, then X_1, X_2, X_3, X_4 are each independently selected from the group -F and -H, and at least one -F is selected, and when A = —N=C(R1)(R2), wherein R_1= CF_3, C_2F_5, C_nF_{2n+1}, R_2= H, CH_3, CF_3, C_2F_5, then X_1, X_2, X_3, X_4 are each independently selected from the group -F and -H;

or second substituted anilines,



Wherein D = donor = $—NH_2$, $—N(CH_3)_2$, $—N(CH_2CH_3)_2$, or – $N(Y)_2$ where Y = alkyl alcohols, alkyl (hydrocarbon or fluorocarbon) esters, or alkyl silane derivatives;

A_1 = primary acceptor = $—NO_2$, $—C(CN)C(CN)_2$, or —N=C (R1)(R2), where R_1= CF_3, C_2F_5, C_nF_{2n+1}, R_2 = H, CH_3, CF_3, C_2F_5

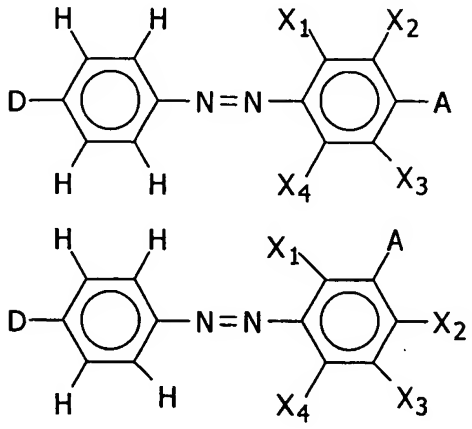
A_2 = secondary acceptor = —CN, or $—CF_3$

wherein X_1, X_2, X_3 are each independently selected from the group -F and -H;

and wherein A_1 can be the same as A_2, wherein two identical or different acceptors may be selected from group A1 or two identical or different acceptors may be selected from group A_2, so that when acceptors are selected from $—NO_2$, $—C(CN)C(CN)_2$, —CN, or $—CF_3$, then X_1, X_2, X_3 are each independently selected from the group -F and -H, and at least one -F is selected; and if at least one acceptor is selected as —N=C (R1)(R2), where R_1= CF_3, C_2F_5, C_nF_{2n+1}, R_2 = H, CH_3, CF_3, C_2F_5, then X_1, X_2, X_3 are each independently selected from the group -F and -H.

18. The functional optical material according to Claim 16, wherein said one or more optically active chromophores is (are) selected from substituted azobenzenes comprising:

first substituted azobenzenes,

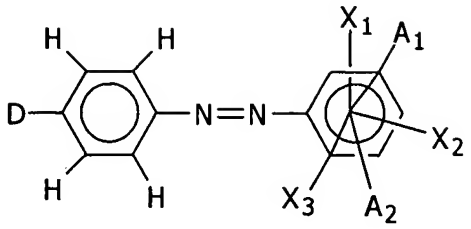


Wherein D = donor = $-NH_2$, $-N(CH_3)_2$, $-N(CH_2CH_3)_2$, or $-N(Y)_2$ where Y = alkyl alcohols, alkyl (hydrocarbon fluorocarbon) esters, or alkyl silane derivatives;

A = acceptor = $-NO_2$, $-C(CN)C(CN)_2$, or $-N=C(R1)(R2)$, wherein R_1= CF_3, C_2F_5, C_nF_{2n+1}, R_2= H, CH_3, CF_3, C_2F_5

wherein when A = = $-NO_2$, or $-C(CN)C(CN)_2$, then X_1, X_2, X_3, X_4 are each independently selected from the group -F and -H, and at least one -F is selected, and when A = $-N=C(R1)(R2)$, wherein R_1= CF_3, C_2F_5, C_nF_{2n+1}, R_2= H, CH_3, CF_3, C_2F_5, then X_1, X_2, X_3, X_4 are each independently selected from the group -F and -H;

or second substituted azobenzenes,



Wherein D = donor = $-NH_2$, $-N(CH_3)_2$, $-N(CH_2CH_3)_2$, or $-N(Y)_2$ where Y = alkyl alcohols, alkyl (hydrocarbon or fluorocarbon) esters, or alkyl silane derivatives;

primary acceptor = $-NO_2$, $-C(CN)C(CN)_2$, or $-N=C(R1)(R2)$, where R_1= CF_3, C_2F_5, C_nF_{2n+1}, R_2 = H, CH_3, CF_3, C_2F_5

secondary acceptor = —CN, or $-CF_3$

wherein if A_1 and A_2 are both primary acceptors selected from $-NO_2$, or $-C(CN)C(CN)_2$, then X_1, X_2, X_3 are each independently selected from -F and -H, but at least one -F must be selected;

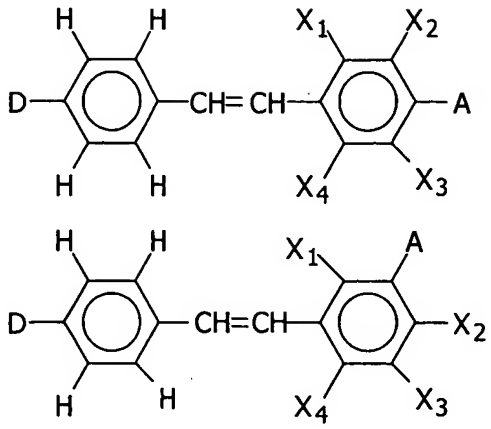
wherein if A_1 and A_2 are both secondary acceptors selected from $-NO_2$, or $-C(CN)C(CN)_2$, then X_1, X_2, X_3 are each independently selected from -F and -H, but at least one -F must be selected;

wherein if A_1 and/or A_2 are selected from the primary acceptor $-N=C(R1)(R2)$, where R_1= CF_3, C_2F_5, C_nF_{2n+1}, R_2 = H, CH_3, CF_3, C_2F_5, then X_1, X_2, X_3 are each independently selected from -F and -H; and

wherein if A_1 is selected from any primary acceptor, and A_2 is selected from any secondary acceptor, then X_1, X_2, X_3 are each independently selected from -F and -H.

19. The functional optical material according to Claim 16, wherein said one or more optically active chromophores is (are) selected from substituted stilbenes comprising:

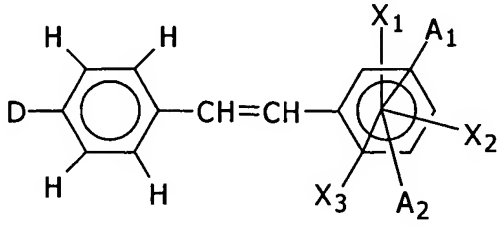
first substituted stilbenes,



Wherein D = donor = $-NH_2$, $-N(CH_3)_2$, $-N(CH_2CH_3)_2$, or $-N(Y)_2$ where Y = alkyl alcohols, alkyl (hydrocarbon fluorocarbon) esters, or alkyl silane derivatives;

A = acceptor = $-NO_2$, $-C(CN)C(CN)_2$, or $-N=C(R1)(R2)$, wherein R_1= CF_3, C_2F_5, C_nF_{2n+1}, R_2= H, CH_3, CF_3, C_2F_5
wherein when A = = $-NO_2$, or $-C(CN)C(CN)_2$, then X_1, X_2, X_3, X_4 are each independently selected from the group -F and -H, and at least one -F is selected, and when A = $-N=C(R1)(R2)$, wherein R_1= CF_3, C_2F_5, C_nF_{2n+1}, R_2= H, CH_3, CF_3, C_2F_5, then X_1, X_2, X_3, X_4 are each independently selected from the group -F and -H;

or second substituted stilbenes,



Wherein D = donor = $—NH_2$, $—N(CH_3)_2$, $—N(CH_2CH_3)_2$, or – $N(Y)_2$ where Y = alkyl alcohols, alkyl (hydrocarbon or fluorocarbon) esters, or alkyl silane derivatives;

primary acceptor = $—NO_2$, $—C(CN)C(CN)_2$, or —N=C (R1)(R2), where R_1= CF_3, C_2F_5, C_nF_{2n+1}, R_2 = H, CH_3, CF_3, C_2F_5

secondary acceptor = —CN, or $—CF_3$

wherein if A_1 and A_2 are both primary acceptors selected from $—NO_2$, or $—C(CN)C(CN)_2$, then X_1, X_2, X_3 are each independently selected from -F and -H, but at least one -F must be selected;

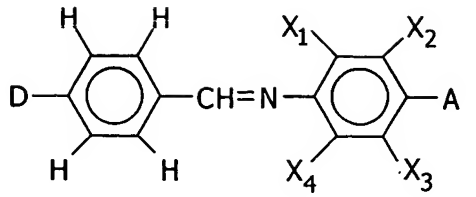
wherein if A_1 and A_2 are both secondary acceptors selected from $—NO_2$, or $—C(CN)C(CN)_2$, then X_1, X_2, X_3 are each independently selected from -F and -H, but at least one -F must be selected;

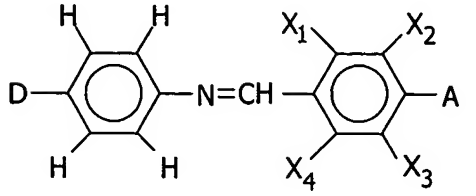
wherein if A_1 and/or A_2 are selected from the primary acceptor —N=C (R1)(R2), where R_1= CF_3, C_2F_5, C_nF_{2n+1}, R_2 = H, CH_3, CF_3, C_2F_5, then X_1, X_2, X_3 are each independently selected from -F and -H; and

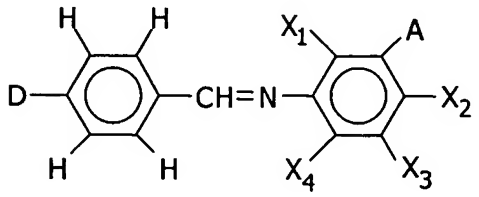
wherein if A_1 is selected from any primary acceptor, and A_2 is selected from any secondary acceptor, then X_1, X_2, X_3 are each independently selected from -F and -H.

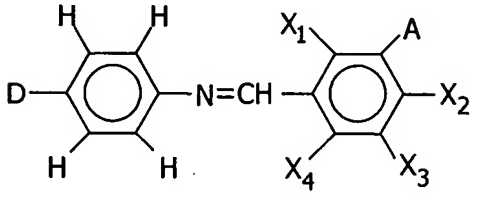
20. The functional optical material according to Claim 16, wherein said one or more optically active chromophores is (are) selected from substituted imines comprising:

first substituted imines,









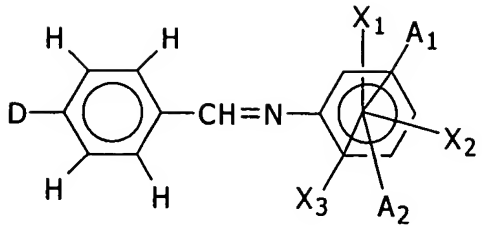
Wherein D = donor = $-NH_2$, $-N(CH_3)_2$, $-N(CH_2CH_3)_2$, or $-N(Y)_2$ where Y = alkyl alcohols, alkyl (hydrocarbon fluorocarbon) esters, or alkyl silane derivatives;

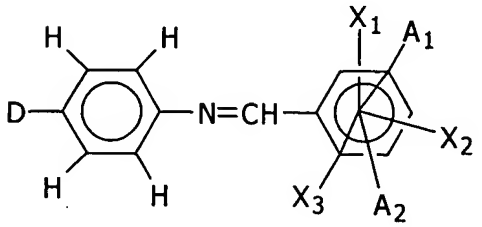
A = acceptor = $-NO_2$, $-C(CN)C(CN)_2$, or $-N=C(R1)(R2)$, wherein R_1= CF_3, C_2F_5, C_nF_{2n+1}, R_2= H, CH_3, CF_3, C_2F_5

wherein when A = = $-NO_2$, or $-C(CN)C(CN)_2$, then X_1, X_2, X_3, X_4 are each independently selected from the group -F and -H, and at least one -F is selected, and when A = $-N=C(R1)(R2)$, wherein R_1= CF_3, C_2F_5, C_nF_{2n+1}, R_2= H, CH_3, CF_3, C_2F_5, then X_1, X_2, X_3, X_4 are each independently selected from the group -F and -H;

or second substituted imines,

21





22

23

24 Wherein D = donor = $—NH_2$, $—N(CH_3)_2$, $—N(CH_2CH_3)_2$, or – $N(Y)_2$ where Y =
25 alkyl alcohols, alkyl (hydrocarbon or fluorocarbon) esters, or alkyl silane
26 derivatives;

27

28 primary acceptor = $—NO_2$, $—C(CN)C(CN)_2$, or —N=C (R1)(R2), where R_1=
29 CF_3, C_2F_5, C_nF_{2n+1}, R_2 = H, CH_3, CF_3, C_2F_5

30

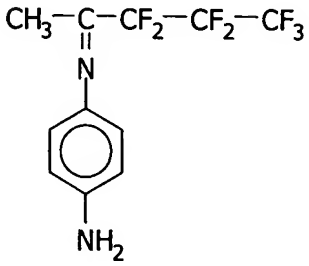
31 secondary acceptor = —CN, or $—CF_3$

32

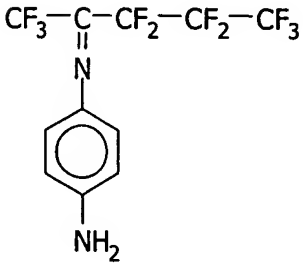
33 wherein if A_1 and A_2 are both primary acceptors selected from $—NO_2$, or
34 $—C(CN)C(CN)_2$, then X_1, X_2, X_3 are each independently selected from -F and -
35 H, but at least one -F must be selected;
36 wherein if A_1 and A_2 are both secondary acceptors selected from $—NO_2$, or
37 $—C(CN)C(CN)_2$, then X_1, X_2, X_3 are each independently selected from -F and -
38 H, but at least one -F must be selected;
39 wherein if A_1 and/or A_2 are selected from the primary acceptor —N=C
40 (R1)(R2), where R_1= CF_3, C_2F_5, C_nF_{2n+1}, R_2 = H, CH_3, CF_3, C_2F_5, then X_1, X_2, X_3
41 are each independently selected from -F and -H; and

wherein if A_1 is selected from any primary acceptor, and A_2 is selected from any secondary acceptor, then X_1, X_2, X_3 are each independently selected from -F and -H.

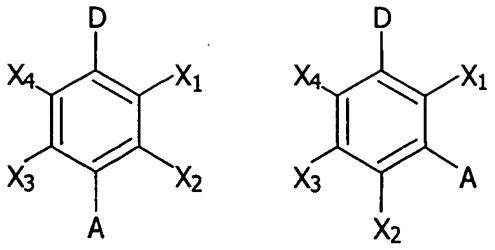
21. The functional optical material according to Claim 16, wherein one of said optically active chromophores comprises:



22. The functional optical material according to Claim 16, wherein one of said optically active chromophores comprises:



23. The functional optical material according to Claim 16, wherein said compatibilizer has a nitrile group, and said one or more optically active chromophores are selected from conventional substituted anilines comprising:

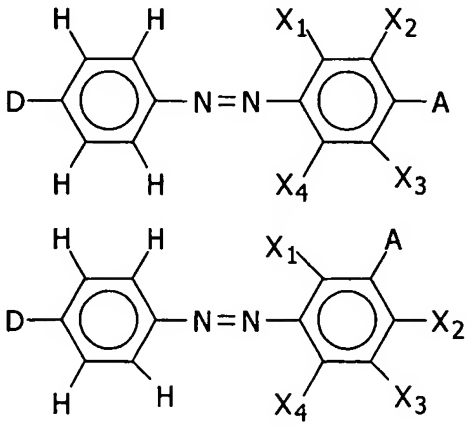


Wherein D = donor = $-NH_2$, $-N(CH_3)_2$, $-N(CH_2CH_3)_2$, or $-N(Y)_2$ where Y = alkyl alcohols, alkyl (hydrocarbon fluorocarbon) esters, or alkyl silane derivatives;

A = acceptor = $-NO_2$, or $-C(CN)C(CN)_2$, and

wherein X_1, X_2, X_3, X_4 are each -H.

24. The functional optical material according to Claim 16, wherein said one or more optically active chromophores is (are) selected from conventional substituted azobenzenes comprising:

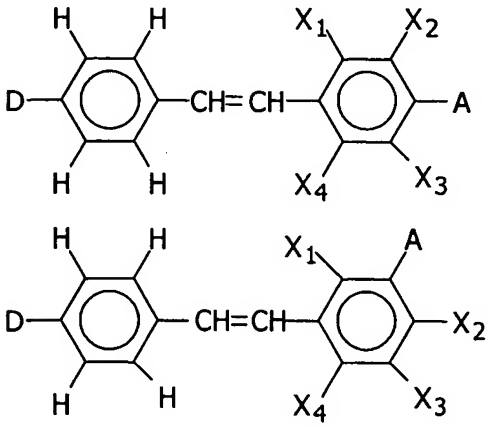


Wherein D = donor = $-NH_2$, $-N(CH_3)_2$, $-N(CH_2CH_3)_2$, or $-N(Y)_2$ where Y = alkyl alcohols, alkyl (hydrocarbon fluorocarbon) esters, or alkyl silane derivatives;

A = acceptor = $-NO_2$, or $-C(CN)C(CN)_2$, and

wherein X_1, X_2, X_3, X_4 are each -H.

25. The functional optical material according to Claim 16, wherein said one or more optically active chromophores is (are) selected from conventional substituted stilbenes comprising:

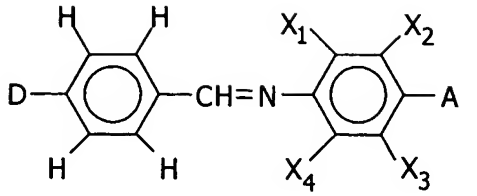


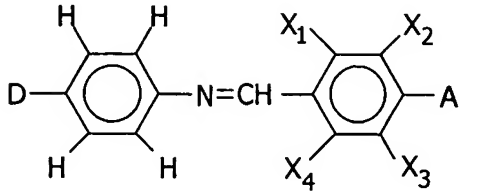
Wherein D = donor = $-NH_2$, $-N(CH_3)_2$, $-N(CH_2CH_3)_2$, or $-N(Y)_2$ where Y = alkyl alcohols, alkyl (hydrocarbon fluorocarbon) esters, or alkyl silane derivatives;

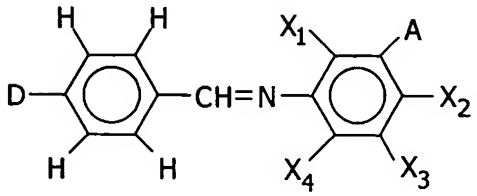
A = acceptor = $-NO_2$, or $-C(CN)C(CN)_2$, and

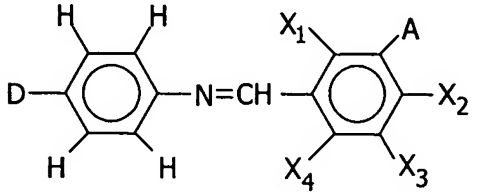
wherein X_1, X_2, X_3, X_4 are each -H.

26. The functional optical material according to Claim 16, wherein said one or more optically active chromophores is (are) selected from conventional substituted imines comprising:









Wherein D = donor = $-NH_2$, $-N(CH_3)_2$, $-N(CH_2CH_3)_2$, or $-N(Y)_2$ where Y = alkyl alcohols, alkyl (hydrocarbon fluorocarbon) esters, or alkyl silane derivatives;

A = acceptor = $-NO_2$, or $-C(CN)C(CN)_2$, and

wherein X_1, X_2, X_3, X_4 are each -H.

27. A functional optical material for use in an optical system, comprising:

(a) a polymer selected from the group comprising,

(1) a thermoplastic polymer;

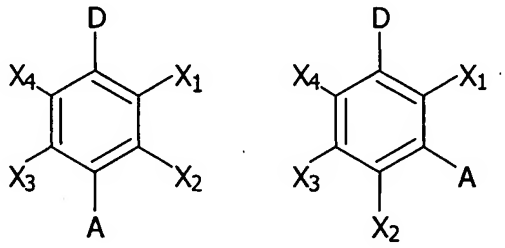
(2) a thermosetting polymer; and

(3) a combination of thermoplastic and thermosetting polymers;

wherein said thermoplastic and/or thermosetting polymers contain carbon-hydrogen and/or carbon-fluoride functionality; and

(b) one or more optically active chromophores blended and/or copolymerized with said polymer, wherein said chromophore comprises:

first substituted anilines

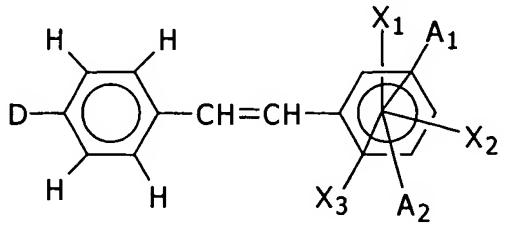


Wherein D = donor = $-NH_2$, $-N(CH_3)_2$, $-N(CH_2CH_3)_2$, or $-N(Y)_2$ where Y = alkyl alcohols, alkyl (hydrocarbon fluorocarbon) esters, or alkyl silane derivatives;

A = acceptor = $-NO_2$, $-C(CN)C(CN)_2$, or $-N=C(R1)(R2)$, wherein R_1= CF_3, C_2F_5, C_nF_{2n+1}, R_2= H, CH_3, CF_3, C_2F_5

wherein when A = = $-NO_2$, or $-C(CN)C(CN)_2$, then X_1, X_2, X_3, X_4 are each independently selected from the group -F and -H, and at least one -F is selected, and when A = $-N=C(R1)(R2)$, wherein R_1= CF_3, C_2F_5, C_nF_{2n+1}, R_2= H, CH_3, CF_3, C_2F_5, then X_1, X_2, X_3, X_4 are each independently selected from the group -F and -H;

or second substituted anilines,



Wherein D = donor = $-NH_2$, $-N(CH_3)_2$, $-N(CH_2CH_3)_2$, or $-N(Y)_2$ where Y = alkyl alcohols, alkyl (hydrocarbon or fluorocarbon) esters, or alkyl silane derivatives;

A_1 = primary acceptor = $-NO_2$, $-C(CN)C(CN)_2$, or $-N=C$ (R1)(R2), where $R_1= CF_3$, C_2F_5, C_nF_{2n+1}, R_2 = H, CH_3, CF_3, C_2F_5

A_2 = secondary acceptor = $-CN$, or $-CF_3$

wherein X_1, X_2, X_3 are each independently selected from the group -F and -H;

and wherein A_1 can be the same as A_2, wherein two identical or different acceptors may be selected from group A1 or two identical or different acceptors may be selected from group A_2, so that when acceptors are selected from $-NO_2$, $-C(CN)C(CN)_2$, $-CN$, or $-CF_3$, then X_1, X_2, X_3 are each independently selected from the group -F and -H, and at least one -F is selected; and if at least one acceptor is selected as $-N=C$ (R1)(R2), where $R_1= CF_3$, C_2F_5, C_nF_{2n+1}, R_2 = H, CH_3, CF_3, C_2F_5, then X_1, X_2, X_3 are each independently selected from the group -F and –H.

28. A functional optical material for use in an optical system, comprising:

(a) a polymer selected from the group comprising,

(1) a thermoplastic polymer;

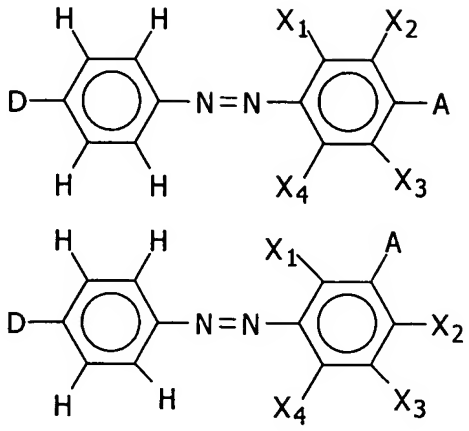
(2) a thermosetting polymer; and

(3) a combination of thermoplastic and thermosetting polymers;

wherein said thermoplastic and/or thermosetting polymers contain carbon-hydrogen and/or carbon-fluoride functionality; and

(b) one or more optically active chromophores blended and/or copolymerized with said polymer, wherein said chromophore comprises:

first substituted azobenzenes

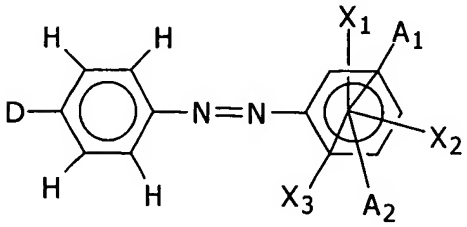


Wherein D = donor = $-NH_2$, $-N(CH_3)_2$, $-N(CH_2CH_3)_2$, or $-N(Y)_2$ where Y = alkyl alcohols, alkyl (hydrocarbon fluorocarbon) esters, or alkyl silane derivatives;

A = acceptor = $-NO_2$, $-C(CN)C(CN)_2$, or $-N=C(R1)(R2)$, wherein R_1= CF_3, C_2F_5, C_nF_{2n+1}, R_2= H, CH_3, CF_3, C_2F_5

wherein when A = = $-NO_2$, or $-C(CN)C(CN)_2$, then X_1, X_2, X_3, X_4 are each independently selected from the group -F and -H, and at least one -F is selected, and when A = $-N=C(R1)(R2)$, wherein R_1= CF_3, C_2F_5, C_nF_{2n+1}, R_2= H, CH_3, CF_3, C_2F_5, then X_1, X_2, X_3, X_4 are each independently selected from the group -F and -H;

or second substituted azobenzenes,



Wherein D = donor = $-NH_2$, $-N(CH_3)_2$, $-N(CH_2CH_3)_2$, or $-N(Y)_2$ where Y = alkyl alcohols, alkyl (hydrocarbon or fluorocarbon) esters, or alkyl silane derivatives;

primary acceptor = $-NO_2$, $-C(CN)C(CN)_2$, or $-N=C(R1)(R2)$, where R_1= CF_3, C_2F_5, C_nF_{2n+1}, R_2 = H, CH_3, CF_3, C_2F_5

secondary acceptor = $-CN$, or $-CF_3$

wherein if A_1 and A_2 are both primary acceptors selected from $-NO_2$, or $-C(CN)C(CN)_2$, then X_1, X_2, X_3 are each independently selected from -F and -H, but at least one -F must be selected;

wherein if A_1 and A_2 are both secondary acceptors selected from $-NO_2$, or $-C(CN)C(CN)_2$, then X_1, X_2, X_3 are each independently selected from -F and -H, but at least one -F must be selected;

wherein if A_1 and/or A_2 are selected from the primary acceptor $-N=C(R1)(R2)$, where R_1= CF_3, C_2F_5, C_nF_{2n+1}, R_2 = H, CH_3, CF_3, C_2F_5, then X_1, X_2, X_3 are each independently selected from -F and -H; and

wherein if A_1 is selected from any primary acceptor, and A_2 is selected from any secondary acceptor, then X_1, X_2, X_3 are each independently selected from -F and -H.

29. A functional optical material for use in an optical system, comprising:

(a) a polymer selected from the group comprising,

(1) a thermoplastic polymer;

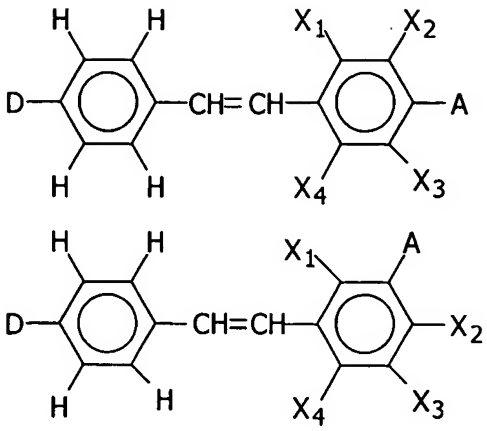
(2) a thermosetting polymer; and

(3) a combination of thermoplastic and thermosetting polymers;

wherein said thermoplastic and/or thermosetting polymers contain carbon-hydrogen and/or carbon-fluoride functionality; and

(b) one or more optically active chromophores blended and/or copolymerized with said polymer, wherein said chromophore comprises:

first substituted stilbenes

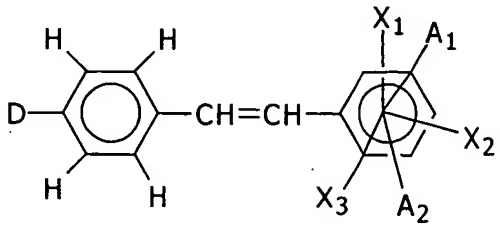


Wherein D = donor = $-NH_2$, $-N(CH_3)_2$, $-N(CH_2CH_3)_2$, or $-N(Y)_2$ where Y = alkyl alcohols, alkyl (hydrocarbon fluorocarbon) esters, or alkyl silane derivatives;

A = acceptor = $-NO_2$, $-C(CN)C(CN)_2$, or $-N=C(R1)(R2)$, wherein R_1= CF_3, C_2F_5, C_nF_{2n+1}, R_2= H, CH_3, CF_3, C_2F_5

wherein when A = = $-NO_2$, or $-C(CN)C(CN)_2$, then X_1, X_2, X_3, X_4 are each independently selected from the group -F and -H, and at least one -F is selected, and when A = $-N=C(R1)(R2)$, wherein R_1= CF_3, C_2F_5, C_nF_{2n+1}, R_2= H, CH_3, CF_3, C_2F_5, then X_1, X_2, X_3, X_4 are each independently selected from the group -F and -H;

or second substituted stilbenes,



Wherein D = donor = $-NH_2$, $-N(CH_3)_2$, $-N(CH_2CH_3)_2$, or $-N(Y)_2$ where Y = alkyl alcohols, alkyl (hydrocarbon or fluorocarbon) esters, or alkyl silane derivatives;

primary acceptor = $-NO_2$, $-C(CN)C(CN)_2$, or $-N=C(R1)(R2)$, where R_1= CF_3, C_2F_5, C_nF_{2n+1}, R_2 = H, CH_3, CF_3, C_2F_5

secondary acceptor = —CN, or $-CF_3$

wherein if A_1 and A_2 are both primary acceptors selected from $-NO_2$, or $-C(CN)C(CN)_2$, then X_1, X_2, X_3 are each independently selected from -F and -H, but at least one -F must be selected;

wherein if A_1 and A_2 are both secondary acceptors selected from $-NO_2$, or $-C(CN)C(CN)_2$, then X_1, X_2, X_3 are each independently selected from -F and -H, but at least one -F must be selected;

wherein if A_1 and/or A_2 are selected from the primary acceptor $-N=C(R1)(R2)$, where R_1= CF_3, C_2F_5, C_nF_{2n+1}, R_2 = H, CH_3, CF_3, C_2F_5, then X_1, X_2, X_3 are each independently selected from -F and -H; and

wherein if A_1 is selected from any primary acceptor, and A_2 is selected from any secondary acceptor, then X_1, X_2, X_3 are each independently selected from -F and -H.

30. A functional optical material for use in an optical system, comprising:

(a) a polymer selected from the group comprising,

(1) a thermoplastic polymer;

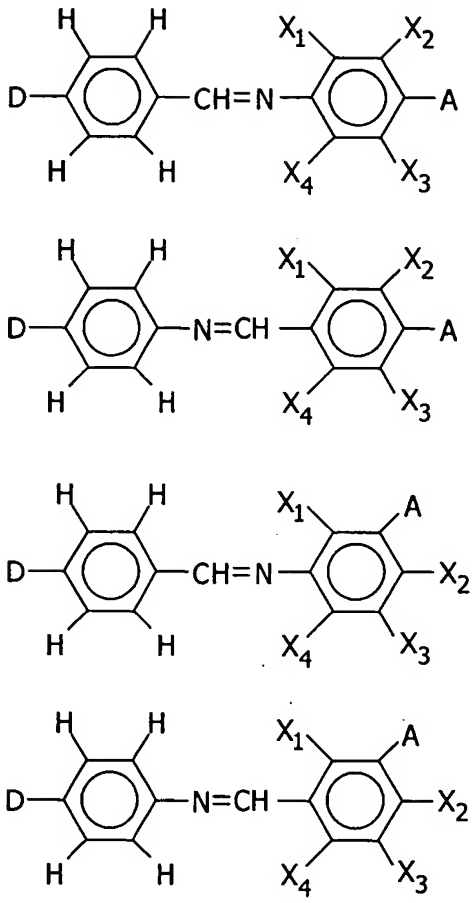
(2) a thermosetting polymer; and

(3) a combination of thermoplastic and thermosetting polymers;

wherein said thermoplastic and/or thermosetting polymers contain carbon-hydrogen and/or carbon-fluoride functionality; and

(b) one or more optically active chromophores blended and/or copolymerized with said polymer, wherein said chromophore comprises:

first substituted imines,

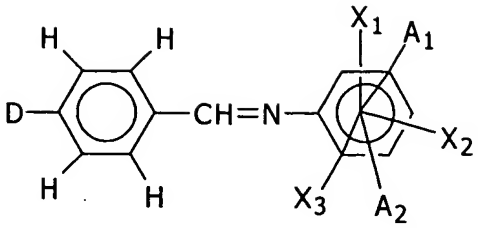


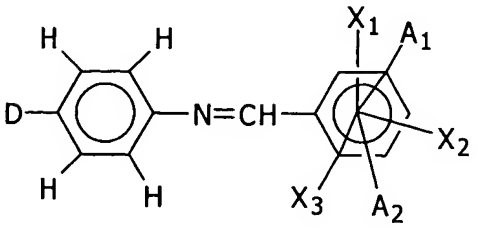
Wherein D = donor = $-NH_2$, $-N(CH_3)_2$, $-N(CH_2CH_3)_2$, or $-N(Y)_2$ where Y = alkyl alcohols, alkyl (hydrocarbon fluorocarbon) esters, or alkyl silane derivatives;

A = acceptor = $-NO_2$, $-C(CN)C(CN)_2$, or $-N=C(R1)(R2)$, wherein R_1= CF_3, C_2F_5, C_nF_{2n+1}, R_2= H, CH_3, CF_3, C_2F_5

wherein when A = = $-NO_2$, or $-C(CN)C(CN)_2$, then X_1, X_2, X_3, X_4 are each independently selected from the group -F and -H, and at least one -F is selected, and when A = $-N=C(R1)(R2)$, wherein R_1= CF_3, C_2F_5, C_nF_{2n+1}, R_2= H, CH_3, CF_3, C_2F_5, then X_1, X_2, X_3, X_4 are each independently selected from the group -F and -H;

or second substituted imines,





Wherein D = donor = $-NH_2$, $-N(CH_3)_2$, $-N(CH_2CH_3)_2$, or $-N(Y)_2$ where Y = alkyl alcohols, alkyl (hydrocarbon or fluorocarbon) esters, or alkyl silane derivatives;

primary acceptor = $-NO_2$, $-C(CN)C(CN)_2$, or $-N=C(R1)(R2)$, where R_1= CF_3, C_2F_5, C_nF_{2n+1}, R_2 = H, CH_3, CF_3, C_2F_5

secondary acceptor = $-CN$, or $-CF_3$

wherein if A_1 and A_2 are both primary acceptors selected from $-NO_2$, or $-C(CN)C(CN)_2$, then X_1, X_2, X_3 are each independently selected from -F and -H, but at least one -F must be selected;

wherein if A_1 and A_2 are both secondary acceptors selected from $-NO_2$, or $-C(CN)C(CN)_2$, then X_1, X_2, X_3 are each independently selected from -F and -H, but at least one -F must be selected;

wherein if A_1 and/or A_2 are selected from the primary acceptor $-N=C(R1)(R2)$, where R_1= CF_3, C_2F_5, C_nF_{2n+1}, R_2 = H, CH_3, CF_3, C_2F_5, then X_1, X_2, X_3 are each independently selected from -F and -H; and

wherein if A_1 is selected from any primary acceptor, and A_2 is selected from any secondary acceptor, then X_1, X_2, X_3 are each independently selected from -F and -H.

31. A functional optical material for use in an optical system, comprising:

(a) a polymer selected from the group comprising,

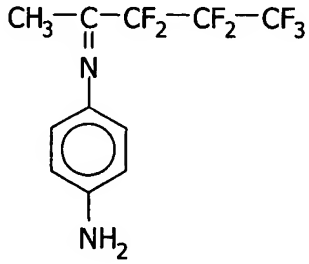
(1) a thermoplastic polymer;

(2) a thermosetting polymer; and

(3) a combination of thermoplastic and thermosetting polymers;

wherein said thermoplastic and/or thermosetting polymers contain carbon-hydrogen and/or carbon-fluoride functionality; and

(b) one or more optically active chromophores blended and/or copolymerized with said polymer, wherein at least one chromophore comprises:



32. A functional optical material for use in an optical system, comprising:

(a) a polymer selected from the group comprising,

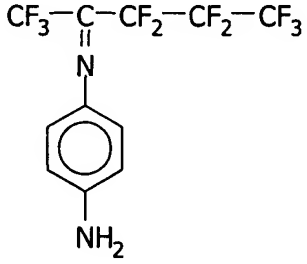
(1) a thermoplastic polymer;

(2) a thermosetting polymer; and

(3) a combination of thermoplastic and thermosetting polymers;

wherein said thermoplastic and/or thermosetting polymers contain carbon-hydrogen and/or carbon-fluoride functionality; and

(b) one or more optically active chromophores blended and/or copolymerized with said polymer, wherein at least one chromophore comprises:



33. A functional optical material useful in an optical system comprising: a polymer of

(a) one or more partially or fully fluorinated first monomer(s) having a refractive index of less than about 1.5, or wherein a homopolymer formed from said first monomer(s) has a refractive index of less than about 1.5;

(b) zero, one, or more second monomer(s) having a refractive index ≥ 1.5, or wherein a homopolymer formed from said second monomer(s) has a refractive index ≥ 1.5;

(c) at least one optically active chromophore;

(d) at least one compatibilizer for said optically active chromophore;

(e) at least one adhesion promoter, having one or more pendant groups selected from the group consisting of nitriles, silanes, fluorinated silanes, organic acids; fluorinated organic acids, alcohols, fluorinated alcohols, amides, and amines; wherein when a compatibilizer with one particular pendant group is selected, an adhesion promoter with a different pendant group is selected.

34. A method of forming a functional optical material comprising:

A. determining if a low index of refraction material ($n<1.5$) or high index of refraction material ($n\geq1.5$) is desired,

B. for a low refractive index optical material

(1) selecting one or more monomers having a low index of refraction;

(2) selecting zero, one, or more monomers having a high index of refraction, wherein the concentration of the monomer(s) with a high index of refraction is less than the concentration of monomer(s) having a low index of refraction;

(3) selecting zero, one or more optically active chromophores;

(4) selecting zero, one, or more of conventional optical chromophores , with the proviso that at least one chromophore must be selected;

(5) selecting one or more compatibilizers for the selected chromophore(s), having one or more pendant groups selected from the group consisting of nitriles, esters, aromatics; fluorinated esters, and fluorinated aromatics; and

(6) selecting one or more adhesion enhancers, having one or more pendant groups selected from the group consisting of nitriles, silanes, fluorinated silanes, organic acids; fluorinated organic acids, alcohols, fluorinated alcohols, amides, and amines; wherein when a compatibilzer with one particular pendant group is selected, an adhesion promoter with a different pendant group is selected; and

(7) mixing and reacting said selected monomer(s), chromophore(s), compatibilizer, and adhesion enhancer.

C. for a high refractive index optical material

(1) selecting one or more monomers having a high index of refraction;

(2) selecting zero, one, or more monomers having a low index of refraction, wherein the concentration of the monomer(s) with a low index of refraction is less than the concentration of monomer(s) having a high index of refraction;

(3) selecting zero, one or more optically active chromophores;

(4) selecting zero, one, or more of conventional optical chromophores , with the proviso that at least one chromophore must be selected;

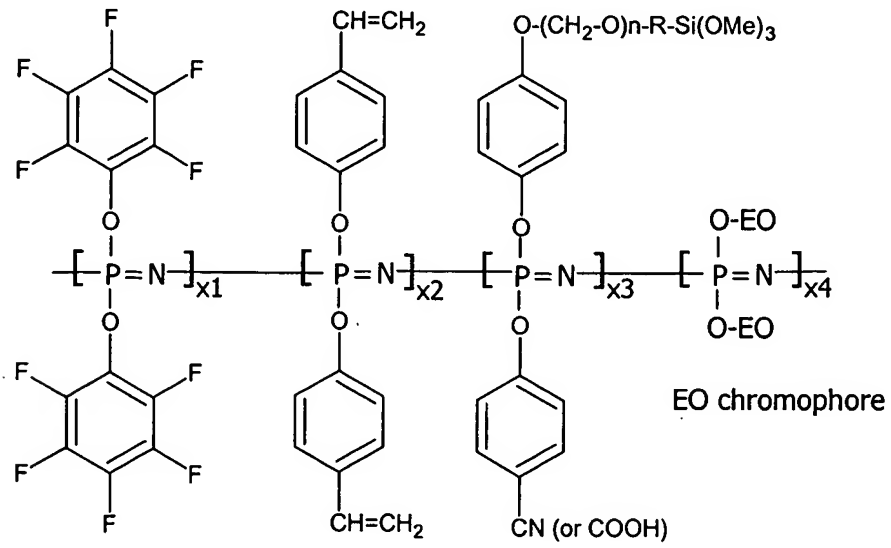
(5) selecting one or more compatibilizers for the selected chromophore(s), having one or more pendant groups selected from the group consisting of nitriles, esters, aromatics; fluorinated esters, and fluorinated aromatics; and

(6) selecting one or more adhesion enhancers, having one or more pendant groups selected from the group consisting of nitriles, silanes, fluorinated silanes, organic acids ????; fluorinated organic acids, alcohols, fluorinated alcohols, amides, and amines; wherein when a compatibilzer with one particular pendant group is selected, an adhesion promoter with a different pendant group is selected; and

(7) mixing and reacting said selected monomer(s), chromophore(s), compatibilizer, and adhesion enhancer.

35. The method according to Claim 34, wherein high T_g materials are prepared by selecting and reacting fluorinated monomers with nonfluorinated monomers.

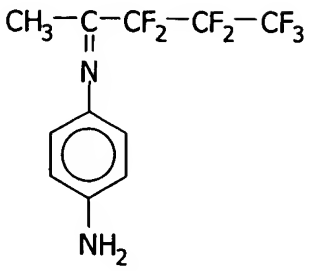
36. A functional optical material for use in an optical system comprising:



wherein x_1 = 50 – 80 wt.%, x_2 = 10 – 15 wt.%, x_3 = 1 – 5 wt.%, x_4 = 5 – 20 wt.%

and wherein one or more of said -F atoms may be substituted by an -H atom.

37. A compound comprising:



38. A compound comprising: